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30 March, 1973

PACKET RADIO COMMUNICATIONS REQUIREMENTS OF A TYPICAL AMPHIBIOUS TASK FORCE

The tactical communications requirements of a typical field army that might be satisfied by a packet radio system were presented in Packet Radio Temporary Note #22. The objective of this note is to extend the survey of representative military applications of packet radio to include the requirements of the U.S. Navy and U.S. Marine Corps in a tactical situation where forces of both services are operating together in a relatively large and continuous local area of operations. This tactical situation involves an Amphibious Task Force (ATF) conducting a landing operation on a distant shore in a mid-intensity nonnuclear conflict. The disposition of both Naval and Marine Corps units in this situation is such that a packet radio network of terminals, repeaters, and stations can serve the needs of the deployed forces for ground-to-ground, ship-to-shore, and ship-to-ship communications without need for long range (beyond nominal radio line-of-sight) links within the ATF area of operations. The tactical communications necessary for the early phases of an amphibious landing support the widest possible range of both Navy and Marine Corps tactical functions and are subjected to the highest level of operational stress.

The ATF for which packet radio requirements are presented in this note is assumed to consist of about 125 Navy ships (with about 400 landing craft) and a Marine Amphibious Force (MAF). The MAF contains one Marine Division (MARDIV), one Marine Air Wing (MAW), and reinforcing and supporting Force Troops under the Landing Force Commander. The total MAF assault force comprises about 30,000 men. The MAW fixed wing

aircraft units are not to be introduced into the combat area during the early period of the landing operation that we will consider in generating communications requirements. Close air support, air strikes, and air defense during the amphibious assault phase with which we are concerned are assumed to be provided by naval aircraft operating from ATF aircraft carriers. As was the case for the field army (see Packet Radio Temporary Note #22), air-to-air and air-to-ground communications requirements will not be stated herein, although many fixed wing aircraft and helicopters will be operating in the ATF airspace during the assault phase of the amphibious operation.

The assault phase begins when the assault elements of the main body of the ATF arrive in assigned positions in the objective area and terminates with the accomplishment of the amphibious task force mission. It encompasses:

(1) Preparation by air strikes and naval gunfire.

(2) Ship-to-shore movement of the landing force by helicopters, landing craft, amphibious vehicles and landing ships.

(3) Landings in landing and drop zones and on beaches by the assault elements of the landing force.

(4) Operations inland to effect juncture between waterborne, helicopter-borne, airborne and/or air-landed assault forces, and to seize the beachhead.

(5) Provision of logistic, air, and naval gunfire support of the attack throughout the assault.

(6) Landing of remaining landing force elements for the conduct of such operations as may be required to complete the accomplishment of the amphibious task force mission.[1]

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[1] References listed on page 10.

aircraft units are not to be introduced into the combat area during the early period of the landing operation that we will consider in generating communications requirements. Close air support, air strikes, and air defense during the amphibious assault phase with which we are concerned are assumed to be provided by naval aircraft operating from ATT aircraft carriers. As was the case for the field army (see Packet Radio Temporary Note #23), air-to-air and air-to-ground communications requirements will not be stated herein, although many fixed wing aircraft and helicopters will be operating in the ATT airspace during the assault phase of the amphibious operation.

The assault phase begins when the assault elements of the main body of the ATT arrive in assigned positions in the objective area and terminates with the accomplishment of the amphibious task force mission. It encompasses:

(1) Preparation by air strikes and naval gunfire.

(2) Ship-to-shore movement of the landing force by helicopters, landing craft, amphibious vehicles and landing ships.

(3) Landings in landing and drop zones and on beaches by the assault elements of the landing force.

(4) Operations inland to effect juncture between waterborne, helicopter-borne, airborne and/or air-landed assault forces, and to seize the beachhead.

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[1] References listed on page 10.

Figure 1 depicts the ATF area of operations in the amphibious assault situation that has been assumed for the development of USN/USMC packet radio requirements. The ATF ships at sea will be operating within a semicircle of about 40 km (25 mi) radius from the center of the MAF rear on the beach. The MAF is assumed to have occupied an area of 30 km (19 mi) frontage, and 40 km (25 mi) depth.

Figure 2 shows typical positions and areas assigned to amphibious units off of the landing beaches. Not shown are the naval gunfire support ships (cruisers and destroyers) that are normally operating close to shore, and the Aircraft Carrier Strike Groups and Antisubmarine Warfare Groups that are normally operating beyond line-of-sight range of the outer limits of the ATF area of operations.

The tactical communications requirements for the ATF have been compiled in detail in recent studies relating to requirements for military satellite communications[2] and to the development of a Landing Force Integrated Communications System (LFICS).[3] These studies have provided the basis for the estimated ground-to-ground packet radio requirements that are tabulated in Table I.*

The ATF communications traffic has been separated into two components for analysis. One component is generated within the MAF Landing Force ashore. The other component involves ship terminals--both ship-to-ship and ship-to-shore-to-ship. These two components are shown separately in Table I, and they also are totalized.

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* See Packet Radio Temporary Note #22 for explanations of the entries in Table I. The Landing Force will normally establish a multichannel communications system ashore, similar to AACOMS, as soon as the tactical situation permits.

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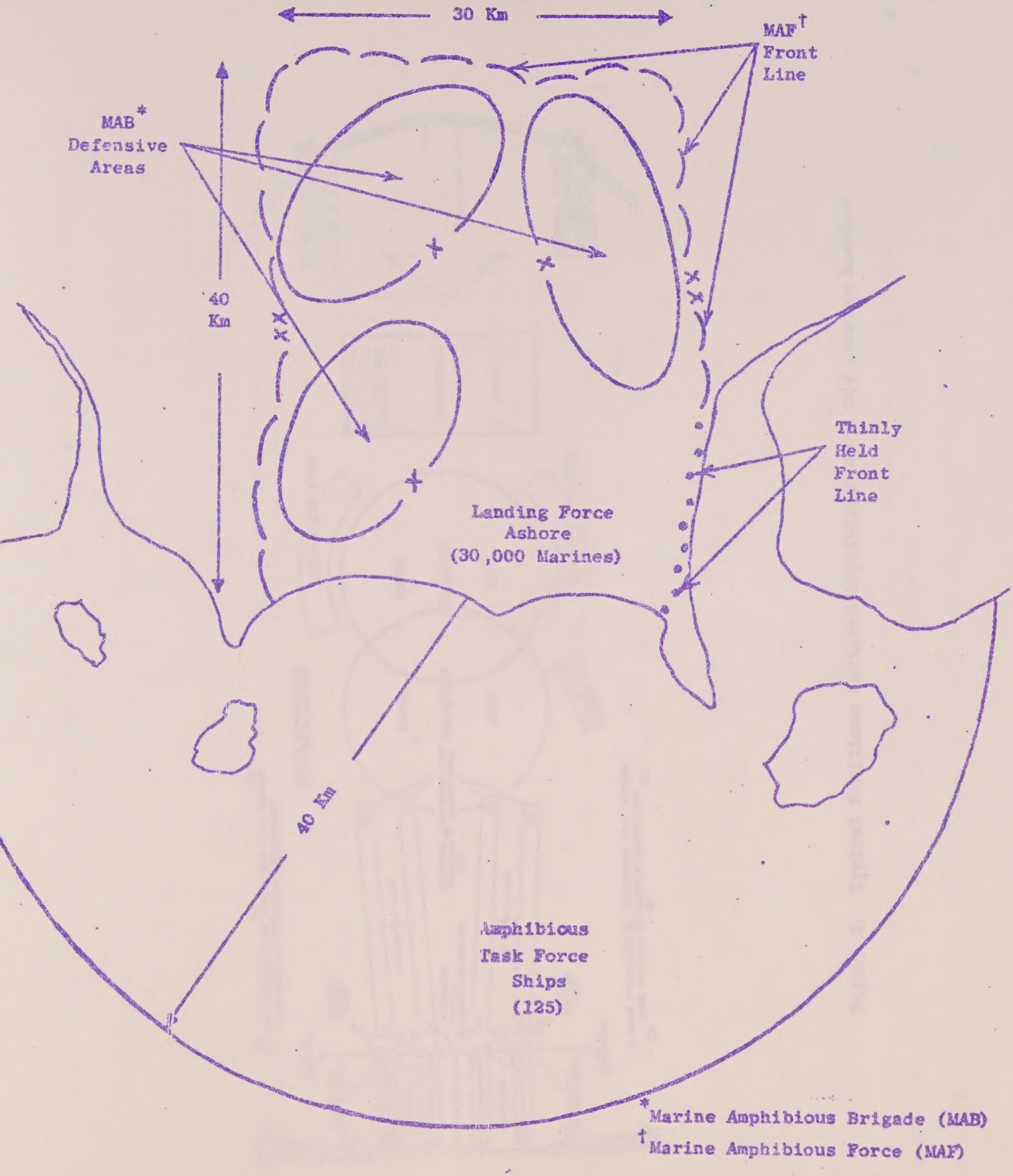
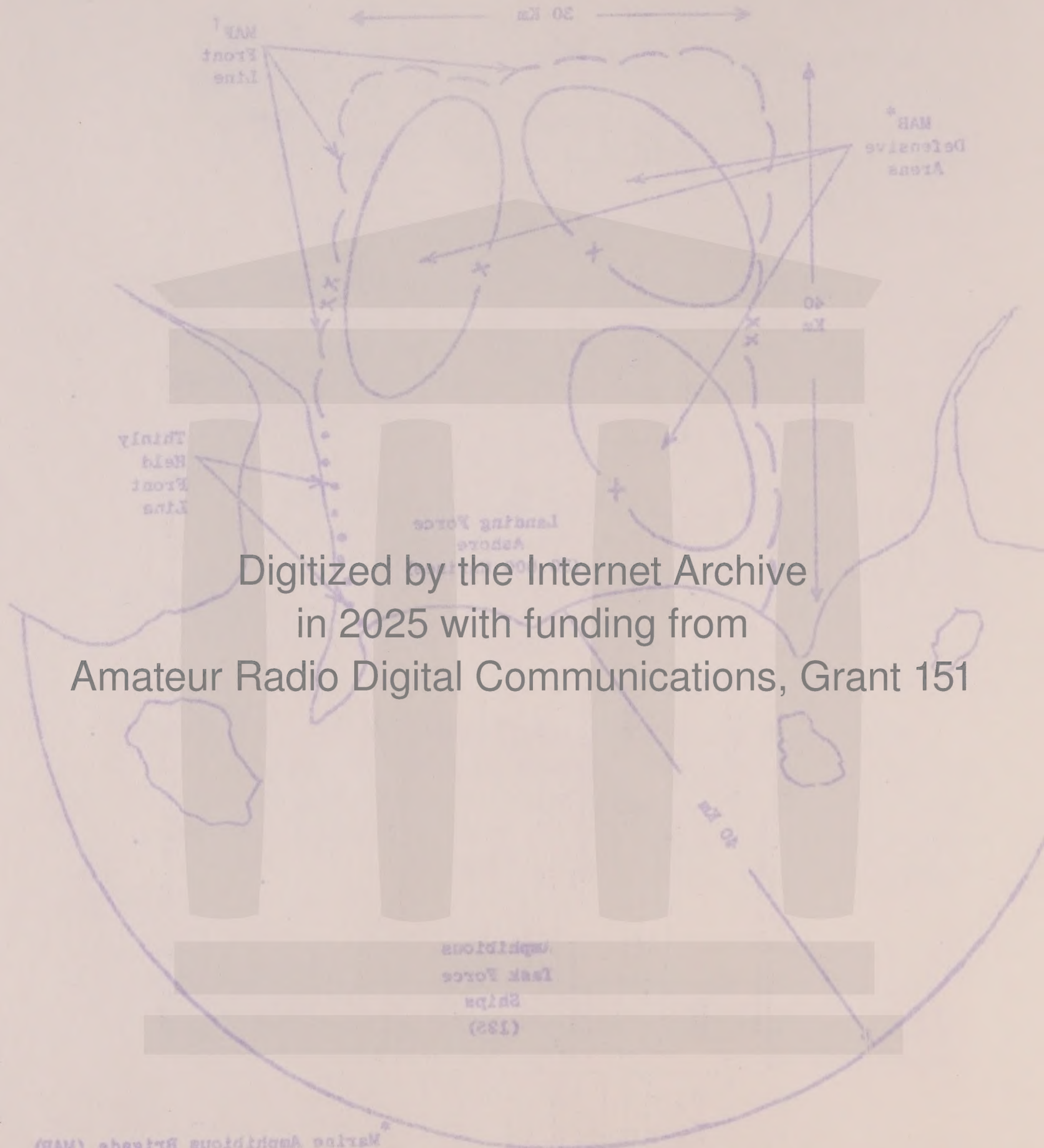


Figure 1. Amphibious Task Force Area of Operations



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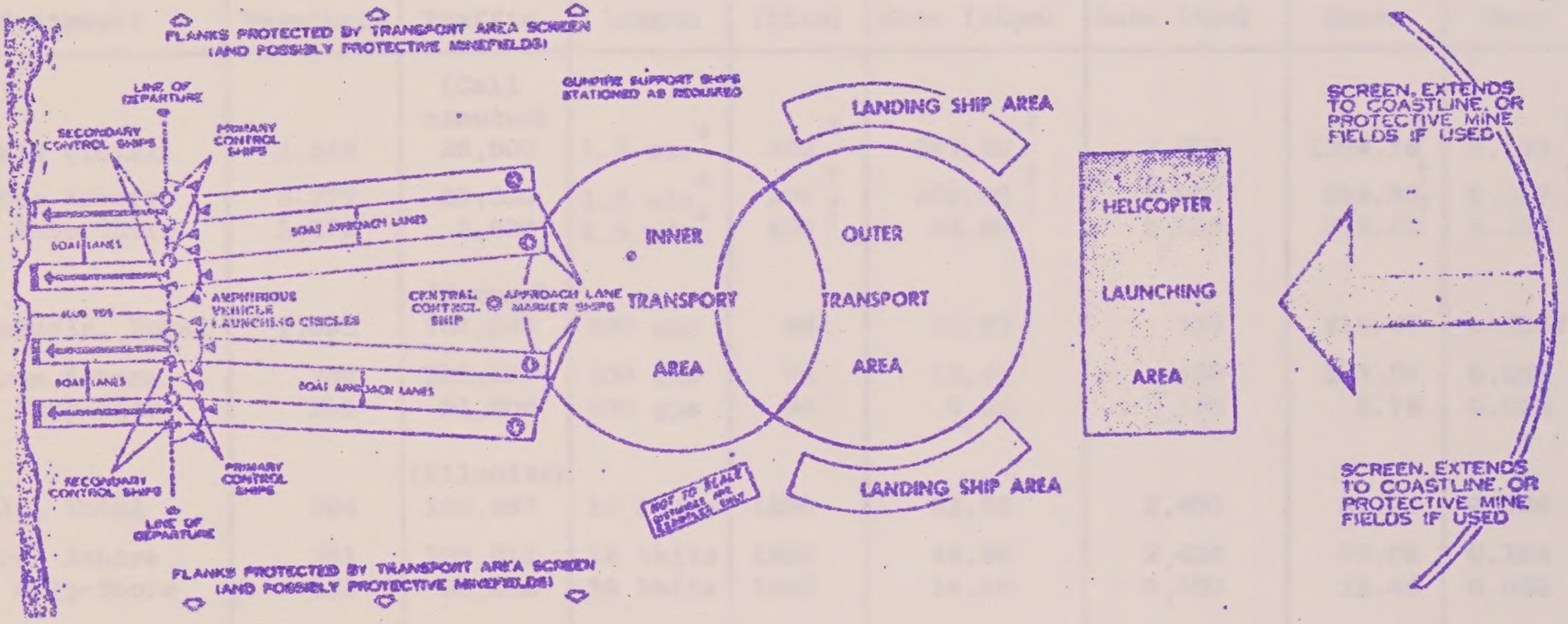
FLANKS PROTECTED BY TRANSPORT AREA SCREEN
(AND POSSIBLY PROTECTIVE MINEFIELDS)
LINE OF DEPARTURE
SECONDARY CONTROL SHIPS
PRIMARY CONTROL SHIPS
GUNFIRE SUPPORT SHIPS STATIONED AS REQUIRED
LANDING SHIP AREA
BOAT LANES
BOAT APPROACH LANES
AMPHIBIOUS VEHICLE LAUNCHING CIRCLES
CENTRAL CONTROL SHIP
APPROACH LANE MARKER SHIPS
INNER TRANSPORT AREA
OUTER TRANSPORT AREA
HELICOPTER LAUNCHING AREA
SCREEN, EXTENDS TO COASTLINE, OR PROTECTIVE MINE FIELDS IF USED
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FLANKS PROTECTED BY TRANSPORT AREA SCREEN
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Figure 2. Typical Positions Assigned Amphibious Units Off Landing Beaches

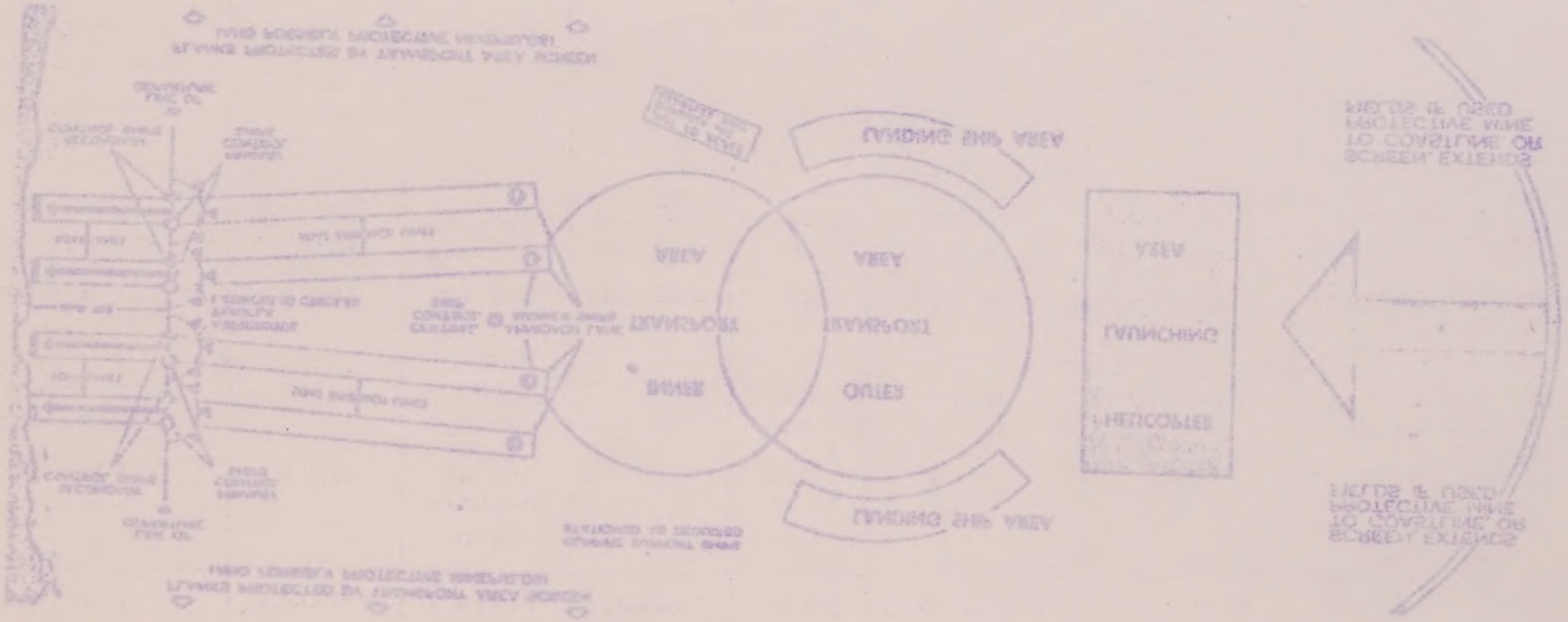

Table I

Estimated Amphibious Task Force Packet Radio Communication Requirements (Ground-to-Ground)

Typical Equipment	Number of Terminals	Peak Hour Traffic	Average Message Length	Packet Size (Bits)	System Information Transfer Rate (kbps)	Terminal Information Transfer Rate (bps)	Information Generation Rate (Packets/Second)		Probability Terminal Transmitting
							All Users	Average User	
		(Call minutes)							
Voice Terminals (Total)	8,349	26,500	1.5 min*	360 †	397.50 †	3,600	1104.16 †	0.133 †	0.053
Landing Force Ashore	6,777	20,600	1.5 min*	360 †	309.00 †	3,600	858.33 †	0.127 †	0.051
Ship-Ship, Ship-Shore	1,572	5,900	1.5 min*	360	88.50	3,600	245.83	0.156	0.063
		(Groups)							
Teletype Terminals, Total	1,091	764,900	400 gps	66	14.02	110	212.47	0.1947	0.112
Landing Force Ashore	782	733,300	400 gps	66	13.44	110	203.69	0.260	0.156
Ship-Ship, Ship-Shore	309	31,600	400 gps	66	0.58	110	8.78	0.028	0.017
		(Kilobits)							
Data Terminals, Total	384	222,667	16 kbits	1200	61.85	2,400	51.54	0.134	0.067
Landing Force Ashore	201	168,811	16 kbits	1200	46.89	2,400	39.08	0.194	0.097
Ship-Ship, Ship-Shore	183	53,856	16 kbits	1200	14.96	2,400	12.46	0.068	0.034
Facsimile		(Pages)							
Landing Force Ashore	642	1,952	1 page	1600	936.96	4,800	585.6	0.912	0.304
Ship-Ship, Ship-Shore	-	0	-	-	-	-	-	-	-
Sensor Control Modules	400								
Position Location (MarDiv)	600								

* The LFICS study assumes the average voice message to be 3 minutes in length. This appears excessive for amphibious assault traffic, where the average voice message length is probably 1.5 minutes at most.

† Voice compression factor = 0.25. Compressed voice information rate is 900 bps (2.5 packets of 360 bits).

The ATF communications traffic is of three types:

(1) That internal to the Landing Force ashore.

(2) That between the Landing Force ashore and the ATF units afloat.

(3) That internal to ATF Naval units afloat.

The maximum communications traffic within the landing force will occur about 3 days after the assault, at which time the division commander will have moved ashore, although the Landing Force Commander is still afloat. The maximum ship-shore and ship-ship traffic will occur about 12 hours after the assault, at which time the MarDiv Commander is still afloat. Communications traffic has been calculated for these peak traffic snapshot times, even though they do not coincide.

The MAF area in the assault situation shown in Figure 1 is only about 40% of the area occupied by an Army division in a defensive posture. This may be accounted for in part by the fact that the MAF has only one protected flank--to seaward.* Table II shows the sizes of the areas of operations of the landing force ashore and the ATF afloat, as derived from Figure 1. The total number of packet radio terminals required and the terminal densities are also shown in this table.

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* A very recent conceptual study of Marine Corps integrated air-ground combat systems employing advance technology post-1980[4] envisions much larger tactical areas of responsibility (TAOR) for the Marine Amphibious Brigade (MAB)--30 to 50 km to a side. The TAOR of a MAF consisting of 3 MABs might be as large as 100-200 km to a side. These large TAORs may not be feasible during the early phases of an amphibious assault.

Table II

Amphibious Task Force Areas and Terminal Densities

	Landing Force (Ashore)	Amphibious Task Force (Afloat)
Areas		
Square Kilometers	1,200	2,513
Square Miles	463	970
Terminals	8,802*	2,064
Terminal Density		
Per km^2	7.34	0.82
Per mi^2	19.01	2.13
Size of Force (Approximate)	30,000 men	125 ships 400 landing craft

* Position location requirements (600) excluded.

The MAF packet radio terminal density would be about 3 times that of the Army Division. This results both from the smaller area occupied during the amphibious assault and the greater number of troops in the MAF--almost double that of an Army Division.

It is of interest to note that the Navy shipboard packet radio terminal distributions represent a situation similar to that of a large building with numerous internal subscribers. For example, the total number of terminals within 6 selected types of ships are shown below:

Ship Type	No. of Ships	Terminals Per Ship
#1	14	27
#2	2	19
#3	23	15
#4	4	14
#5	38	12
#6	16	6

The terminals within each ship are required primarily for external communications. Continuity of the ATF packet radio system appears to require that each of the 6 types of ships listed above have the capability of acting as a packet radio repeater, to relay messages as well as to serve the needs of the ship's internal terminals.

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References

1. "Doctrine for Amphibious Operations," FM 31-11/NWP 22(B)/AFM 2-53/ LFM 01, Departments of the Army, the Navy, and the Air Force, 1 August, 1967.

2. Ward F. Hardman, "Requirements for U.S. Military Command Control Communications By Satellite (U)," Volume I, "Compilation and Analysis of the Requirements Data Base," (Prepared for the Joint Chiefs of Staff), Final Technical Report, Stanford Research Institute, Menlo Park, California; May, 1970. SECRET

3. "Landing Force Integrated Communications System (LFICS) Study," Volume III, "LFICS Communications Requirement," Final Report, Martin-Marietta Corporation, Orlando, Florida; December, 1971.

4. F.P. Henderson, "The Marine Search and Attack System, A System Concept for the Marine Amphibious Brigade," RCA; September, 1972.

References

1. "Doctrine for Amphibious Operations," FM 31-11/MCP 22(B)/AFM 3-85/NWP 22(B), Departments of the Army, the Navy, and the Air Force, August, 1967.

2. Ward F. Hardman, "Requirements for U.S. Military Command Control Communications By Satellite (U)," Volume I, "Compilation and Analysis of the Requirements Data Base," (Prepared for the Joint Chiefs of Staff), Final Technical Report, Stanford Research Institute, Menlo Park, California; May, 1970. SECRET

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